Peter, July 17, 2001

Sorry about the confusion on dark water (blue sea, open ocean) yesterday. This memo is intended to quickly illustrate some of our problems relating to sea optics — and why we need the blue water measurements. The memo has 3 figures.

We have a good, but not complete, set of measurements at COVE. Water depth at COVE is 11m. As we are only 25 km from the coast, the water at COVE does not completely represent that of the open sea.

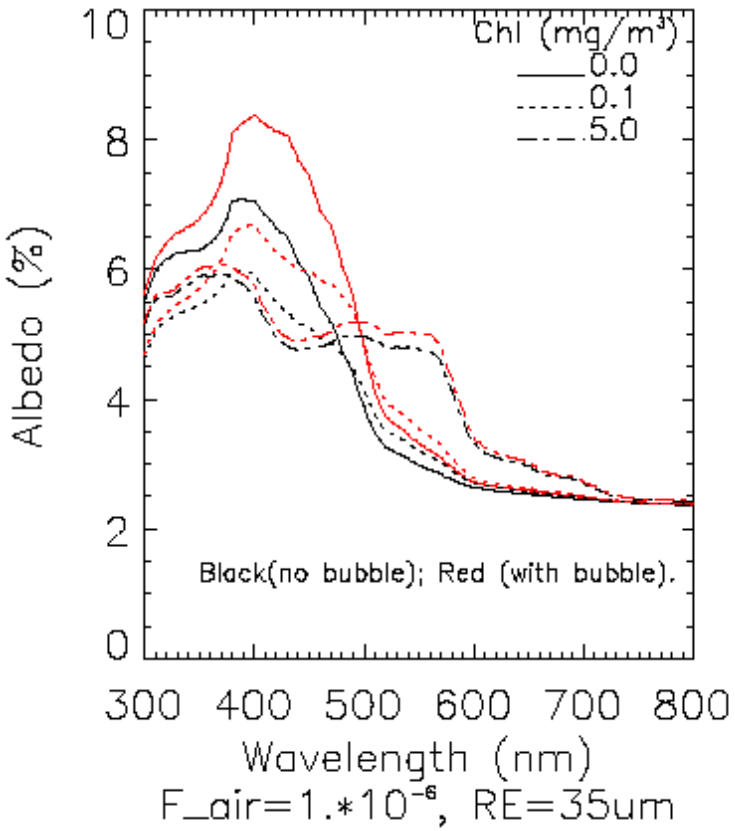
There was a question yesterday on the near UV, which is covered by Figure 1. Figure 1 shows how the spectral albedo should depend on (1) chlorophyll concentration and (2) bubbles. This was computed by Zhonghai Jin using the Jin-Stamnes code, which accounts for scattering and absorption explicitly in BOTH the sea and the air, as well as the usual Cox-Munk distribution of wave facets. In the blue water, the chlorophyll is around 0.5 mg/m3. At COVE, it is ~10 times that amount. SeaWifs provides retrievals of chlorophyll. The bubbles are included here to illustrate a wild card that we are up against. The bubbles are definitely in sea, but hardly anyone accounts for them. Zhonghai s estimate for the bubbles (mixing ratio of 1.e-6 and radius of 35 micron) is reasonable. The code has simulated the effect of depth to bottom, dissolved organic mater (DOM), and other factors.

Figure 2 shows how 3 months of cloud cleared surface radiation at COVE compares with simulations by Z. Jin. The discrepancy in broadband downwelling could be explained by measurement uncertainty, ignorance of near IR AOT, etc. But the general result — wherein observed albedo is slightly larger than simulated — is also seen by Fred Rose with our version of the Fu-Liou code. What is the effect of such tiny (~0.01 absolute) differences in sea albedo? At TOA, it is comparable to aerosol forcing:

cosSZA	AOT forcing Tau 0.0 — > 0.10	Surface albedo Increase by 0.01
0.25	9.3 Wm-2	2.0 Wm-2
0.50	10.1 Wm-2	4.8 Wm-2
1.00	7.2 Wm-2	9.4 Wm-2

Figure 3 is an early comparison of observed and computed BRDF by Wenying Su. Surface BRDF is an important boundary condition for sensing of AOT with satellite data. We seek better surface BRDFs, as well as spectral albedos.

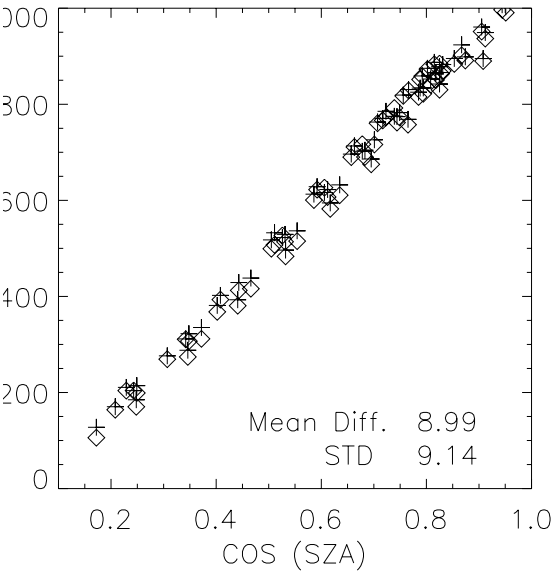
Tom
cc: Zhonghai, Wenying, Bill, Ralph, Vanderlei, Jens, Charles, Michael, Fred, Lorraine

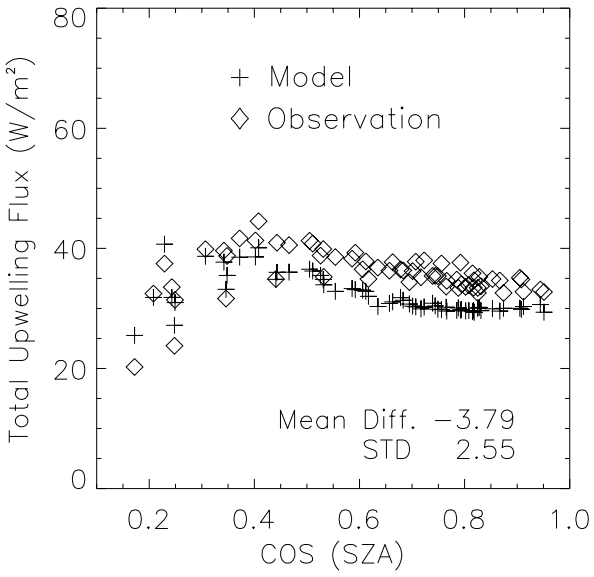


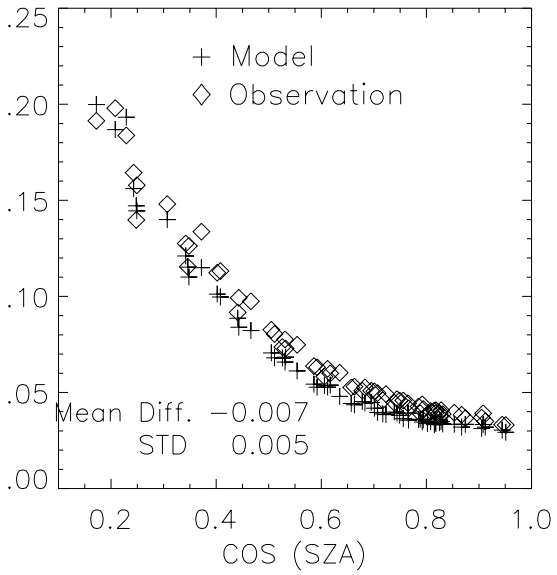
(Jin)

Ocean spectral albedo is influenced by several variables.

Chlorophyl	typical sea concentration is 0.3 mg m-3
	varies seasonally at COVE by ~factor 10
Bubbles	definitely in the sea, but rarely accounted







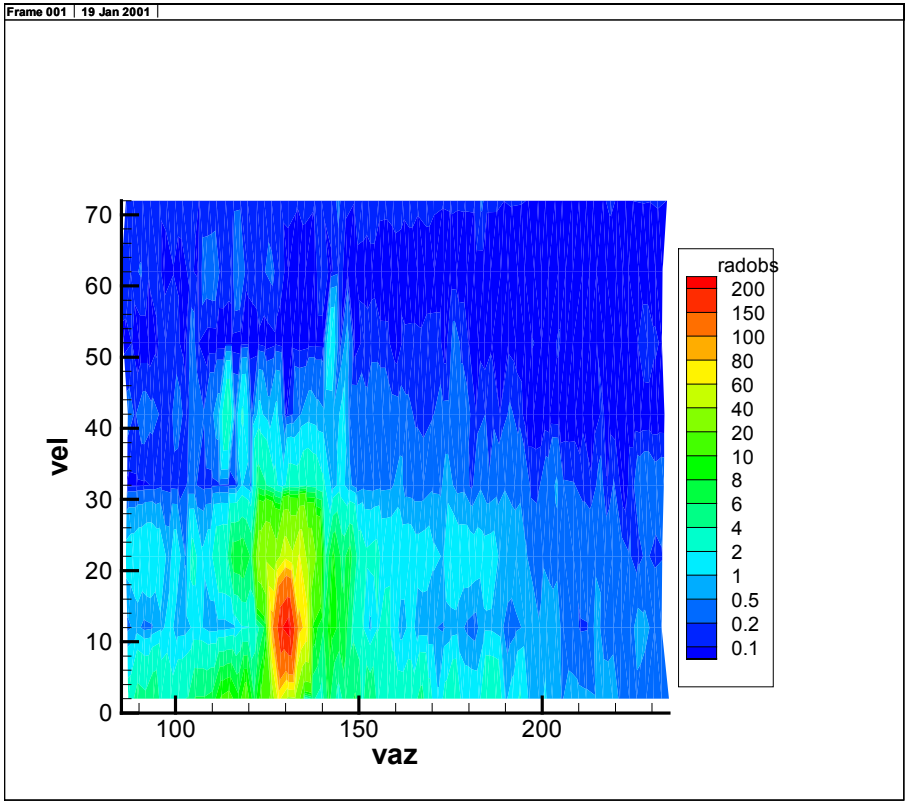
	Mean	Min.	Max.
Wind Speed (m/s)	5.25	0.97	11.18
AOD (500nm)	0.149	0.047	0.383
PW (cm)	1.43	0.59	3.48

MARCH APRIL MAY

Radiance (uW/cm2/um/sr) for 2001-007 13GMT from 5-minute average.

SZA from 82.33 to 82.69, SAA from 124.45 to 124.99(±180).
Average wind speed is 8.5 m/s and direction at 154.6. AOD is 0.151.

measurement



6S simulation